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MARINE SCIENCES IN NORTHERN IRELAND AND EIRE

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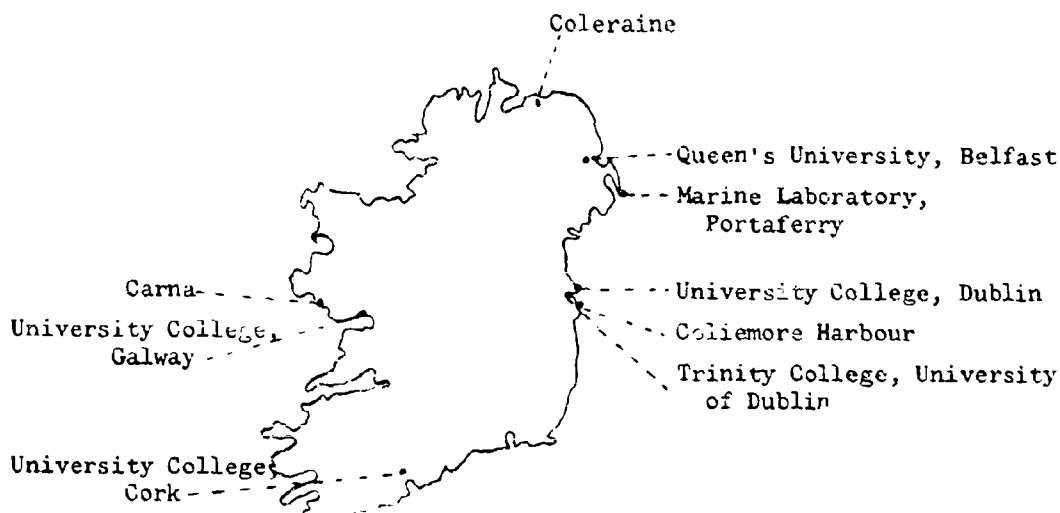
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MARINE SCIENCES IN NORTHERN IRELAND AND EIRE

For a country which boasts that the sea is never more than 75 miles away, Ireland has only recently begun to make progress toward the use of this major resource in its teaching, its research, and its economy. Considering the island as a whole, without dividing it into its political parts, there are five institutions which have varying degrees of interest in the marine sciences. In Northern Ireland the Queen's University of Belfast has been struggling to develop a modern marine laboratory. Some members of the staff of Trinity College and University College, Dublin, University College, Cork, and University College, Galway, are also involved in research on marine organisms, and attempts have been made over the years to maintain field stations for teaching and research at most of these institutions. This report will attempt to summarize the activities of these staffs, briefly describe the facilities which are available, and consider plans to further develop the marine sciences in Northern Ireland and Eire.



Queen's University, Belfast

Prof. Garth Owen, approximately 48, has been at Queen's University for about two years. Previously he was on the staff at the University of Glasgow, Scotland. His own research has been concerned with several aspects of the biology of the mollusc Solemya parkinsoni, including the nutrition, the nature of the elastic fibers, the structure of the mantle, and the relationship between mantle and shell. He is currently involved in electron microscopy of the mantle and shell structure. Several years ago he worked at the marine station at Portobello, New Zealand, under a John Murray Studentship of the Royal Society. Owen took over the Department of Zoology at an extremely difficult time. The University had, some two years earlier, adopted the quinquennial budgeting system and his predecessor, not familiar with the system had assumed that the less he requested at the time, the more would be available during his successor's first year. Unfortunately it doesn't work this way and Owen found the department with virtually no budget. He has done remarkably well, however, and is attempting to strengthen the staff, increase the facilities which are available for research at the University, and convince the University of the need to arrive at a decision concerning the development of the laboratory at Portaferry.

Within the Zoology Department there are four other staff members who are interested in the marine sciences: P.J.S. Boaden, R.V. Gotto, G. Williams, and C. Stanley.

Boaden, approximately 30, received his PhD from University College of North Wales, and has been at Queen's a very short time. Within Strangford Lough, on which the University marine laboratory is located, he has been sampling six stations in a study of interstitial fauna. In addition to a general survey of animals and their distribution, he is interested in the relationship between particle size, species size, and distribution. He feels that one of the distorting factors in such a study has been detritus particle size as opposed to the total mass of detritus, and he is attempting to determine the relationship between these two and their possible role in the environment. He has also worked in Wales and at the Naples laboratory and has published a number of descriptive papers on the interstitial fauna (gastrotrichs and turbellarians) from these areas.

Gotto has been Lecturer in the Department for a number of years and is presently working with parasitic copepods. Although much of his work is taxonomic he is also interested in the locomotion of certain of the parasitic copepods, their feeding mechanisms and habits, and specific adaptations which permit adhesion to the host.

Williams, approximately 63, has been with the Department for many years and is now Senior Lecturer. His departmental duties, coupled with his efforts to expand the marine laboratory, have left little time for research.

Stanley, approximately 30 and only recently added to the Zoology Department staff, has been doing research on the ecology of the scallop, Pectec maximus. His primary interest has been to determine the relationship between linear growth rates and the depths and water temperatures of the scallop communities. He has also been investigating the seasonal cycle of growth in relation to the wet weight, dry weight, and protein content of muscle and gonad.

Interest in a marine laboratory in Northern Ireland has waxed and waned for many years. In 1903, in collaboration with several naturalist groups, the Ulster Fisheries and Biology Association was formed under the direction of Prof. G. Wilson. Modest facilities were rented, a resident naturalist was appointed, a steam launch was purchased, and a boatman retained. This laboratory, established at Larne Harbor, functioned until about 1908 when it was closed for lack of use and interest. During the next 30 years research was conducted sporadically at Ardglass, where laboratory space for short periods was provided up to 1939 by the Ministry of Commerce. Immediately before World War II the University rented a house at Portaferry, which is approximately 25 miles from Belfast on Strangford Lough. In 1945 this building was purchased and converted into a biological station for the promotion of undergraduate and graduate training and research. A second building was purchased in 1960, and during the last year a new laboratory constructed. At the present time the activities of the laboratory are directed largely by a committee representing a number of departments within the University, although Zoology and Botany are the only ones which actually use the facilities. In the official sense there is no director, although Mr. Williams has obviously served in this capacity for a number of years. The station is ideally located for investigations in many areas of the marine environment.

From the laboratory it is four miles to open water at the mouth of the Lough or about eight miles to the northern end. Two small rivers empty into the Lough but the salinity (32-34 p.p.t.) remains relatively constant. The depth varies considerably, ranging from a maximum of approximately 55 meters to 4 meters in the more shallow areas in the north. In the deeper parts the bottom is rocky, making dredging operations difficult, while nearer in-shore this is replaced by gravel, then sand and mud. Williams has pointed out that the fauna of the Lough and the adjacent coast is enriched considerably by cold water forms which have presumably invaded the area by way of St. George's Channel (Irish Sea).

With the exception of the 1966 research laboratory, the converted facilities at Portaferry are strongly reminiscent of some of the smaller field stations that a number of American universities maintained for many years. The two older houses have been converted largely for housing the visiting groups that use the laboratory and will now accommodate between 50 and 56 people. Several rooms have been set aside for staff who wish to make more regular visits, and cooking facilities are available. The

new laboratory, designed as one large, single room, plus the conversion of several large rooms in the older buildings, provides desk space for approximately 55 students. A circulating sea-water system has recently been installed. Although the centrifugal pumps are galvanized iron, the lines are PVC, carrying water from the Lough to a gravity tank in the attic and thence to the various research areas.

The University has recently provided 24 compound microscopes and 12 dissecting microscopes for use at the laboratory. There was little specialized equipment in evidence but since the laboratory is readily accessible to the University it has been customary to bring equipment from the University when it is required. Boaden has been attempting to use a Coulter counter in connection with his research on interstitial fauna but certain basic problems must be overcome before the regular use of specialized equipment will be practicable. As is frequently the case in isolated areas, there are tremendous fluctuations in electric power and Boaden has been doing most of his counting between 2300 and 0500 hours. Negotiations are underway with the Electricity Board to correct the problem but, inasmuch as new cables and considerable expense are involved, it may take some time to arrive at a real solution.

The laboratory has a 36-ft wooden research vessel, SEPIA, which was locally built about five years ago. I did not have an opportunity to see the vessel but understand that several of the staff have used her in connection with general surveys of the Lough and for providing material for study by the various student groups.

In addition to students and staff of Queen's University, the laboratory is used by visiting classes from other institutions. Some, for example the Belfast Technical Institute, have been bringing study groups to Portaferry for a number of years. The spring vacation course is taught by the staff of the Zoology Department, each taking a portion which is related to his general research interests.

Prof. Owen feels quite strongly that a decision must soon be made concerning the development of the laboratory and the role which the University will play. If the laboratory is to contribute to the training and research program of the University, Owen feels that efforts should be made to recruit a nucleus of permanent staff at Portaferry, provide them with the necessary tools for research, and encourage the use of these facilities by other staff in a year-round training program. If the University does not feel that the laboratory can contribute to the overall sciences programs, the monies spent to maintain the facilities at the present threshold level could be better allocated to other aspects of the sciences program.

The future of the laboratory, while dependent in part upon the attitude of Prof. Owen and Queen's University, is also linked to several

other recent developments in Ireland; for example, a new university has been started at Coleraine in the northeast, approximately 50 miles from Belfast, and the relationship between the two Northern Ireland institutions will undoubtedly influence the general policy toward the Portaferry facilities. Prof. Owen is hopeful that the Coleraine scientific faculty, which has yet to be recruited, will be interested in emphasizing limnology and terrestrial biology and will develop field facilities for training and research in these disciplines. In this way the universities could become more specialized within their own areas of interest, exchange students, and avoid duplication of effort and competition for the relatively limited funds available. A recent advertisement in the London Times would suggest that his hopes may be realized. The ad, recruiting staff for the new university at Coleraine, indicated a preference for scientists with interests in freshwater and terrestrial biology. The recent interest in the Irish Sea (see ESN-21-5) should also provide additional opportunities for cooperative research, between individuals as well as institutions, and lead to greater and more effective utilization of the facilities at Portaferry.

University College, Dublin

Neither of the two universities in Dublin have formal programs in marine biology but a number of the staff are involved in research in the marine sciences. Prof. C.F. Humphries, University College, Dublin, has recently moved to a new science building which reflects her basic interest in supporting research and teaching in the marine environment. Design of the portion for the Zoology Department includes a large tiled aquarium room, water tables and glass aquaria, and a recirculating sea-water system which holds approximately 20,000 gallons. The main reservoir, although below ground and covered by a considerable thickness of concrete, does not completely solve the problem of temperature changes throughout the year. Apart from this, however, the system is well designed and could serve as an excellent model for inland universities and colleges interested in recirculating seawater systems. Third year students, varying in number from 7-10, are taken to the small field station on Dublin Bay each spring for the "vacation course" in marine biology which is taught by several of the staff. The Crawford Hayes Marine Biological Station, University College, Dublin, was transferred from its original site at Dun Laoghaire to Dalkey in 1949. Dalkey, now a part of greater Dublin, is situated about nine miles southeast of the city's center. The Biological Station is located at Coliemore Harbour. This granite headland, jutting into Dublin Bay, is separated from several small, off-shore islands by a deep narrow sound. This area has been studied by several members of the staff in recent years. At the present time there are seven graduates, some of whom are working on marine problems. Although Prof. Humphries' research interests are not specifically in marine biology she has published results of cooperative research with other members of the department. Prof. Humphries is obviously aware of the advantages of modern

equipment for certain types of research and has done remarkably well in providing for her staff on a limited budget.

Margaret Duhig, Assistant Lecturer, has been studying the amphipods of Dalkey Island and in the neighbouring waters of Dublin Bay. Her interests have been to obtain faunal records for the district and general information relating to the ecology and breeding period of the amphipods collected. Several publications have resulted from this study and describe the species present, consider the distribution and zonation, and other general ecological aspects.

John Bracken, formerly of the Fisheries Division, Dublin, has recently joined the Zoology staff as an Assistant Lecturer. Bracken's research has been directed toward fisheries dynamics, with emphasis on the herring fisheries, catch and effort data, age data, and efforts to demonstrate the relationship between mortality and effort.

A third Assistant Lecturer in the department, Yvette Ramsay, is concerned with the effects of salinity on thyroid activity in fish, the "amnion" of developing guppies, and chromatographic separation of iso-enzymes.

Mrs. B. Healy, Assistant in the Department, has completed an ecological study of a salt marsh adjacent to Dublin Bay. The study was initiated because of proposed changes in the area but there seems to be, unfortunately, little urgency in publication of the results. All animal groups in the marsh were studied but some only superficially because of the magnitude of the task. At the present time Mrs. Healy is unable to present any conclusions on zonation within the marsh because of the erratic distribution which she observed.

Trinity College, Dublin

Two of the staff of Trinity College, Dublin are engaged in research on marine animals and their studies have obviously been encouraged and facilitated by the Professor, Jack Grainger. D.I.D. Howie has been interested in the hormonal control of gonad development in the lugworm, Arenicola marina. Through cytological and histochemical studies of normal and decerebrated lugworms, Howie has shown that ripening and spawning of the eggs is under humoral control. The "maturation" hormone, originating from the prostomium, can be recovered from male and female tissues but is absent from both sexes during the period prior to breeding. In recent years Howie has been made Dean of Sciences of the College and is devoting a considerable amount of time traveling and on official business. It is hoped that he will be able to continue his present line of research, if only on a limited scale.

B.L. Powell, Assistant Lecturer in the Department of Zoology, has been studying the hormonal control of several processes in adult crustaceans.

Initially he was interested in rhythmic changes in the chromatophores of the crab, Carcinus maenas, the chromatophorotropins which control these changes, and the source of the hormones. Powell has also been working on the hormonal control of the tidal rhythm of locomotory activity in the shore crab and, in recent years, has concentrated more on the sinus gland hormones in an effort to extract, purify, and characterize the individual hormones. Although most of his studies have been on the shore crab, he has done some work with Ligia occidentalis, an intertidal isopod.

One member of the staff at the National Museum in Dublin, C.E. O'Riordan, is also involved in research on marine animals. He has been continuing earlier work on the inshore plankton of the Dalkey area with emphasis on the interstitial copepods. In addition to a general survey of the area O'Riordan has been interested in the position of the copepods on the beach in relation to tidal levels. From recent work he has found that the organic contents in different substrata do not vary in relation to grain size. O'Riordan has also completed a description of the Irish barnacles housed in the Museum collection.

University College, Cork

At the University College, Cork, interest in marine biology is confined largely to Prof. Fergus J. O'Rourke. For a number of years the Department maintained a small field station at Lough Ine, near Baltimore, Ireland. As a field station it was used by students during the course which was given each Easter vacation. In recent years, however, there has been little effort and even less financial support to maintain the facility. The Zoology Department occupies a cramped portion of a typical Victorian building which must date from the 1880's. Although Prof. O'Rourke indicated that the need for a new building was being considered and that it would be available at some future date, it is unlikely that a department which has subsisted on a yearly budget of approximately £ 350 for many years will rate very high in the priority list. With his responsibilities as professor and a working budget of this size, exclusive of staff salaries, it is remarkable that Prof. O'Rourke has managed to continue any research and sustain an interest in several disciplines over the years. He has been interested in comparative serology of fish and, with Bro. P.J. Haen -- a Demonstrator working for the PhD -- has been doing some research in this area. Very little modern equipment is available in the Department but Bro. Haen was engaged in chromatographic studies with what appeared to be largely "home-made" equipment. O'Rourke is widely read and retains an active interest in medical applications of basic research. In 1965 he presented the fifth Graves Lecture to the Royal Academy of Medicine in Ireland.

University College, Galway

The University College which seems to have the greatest interdepartmental effort in the area of the marine sciences is Galway. Padraig Ó Céidigh, approximately 35 and Professor of Zoology for the past eight years, considers himself a marine biologist and is making slow but steady progress in the development of facilities for research and teaching in his department. The new building, shared with several other departments in the natural sciences, has some excellent basic equipment. The Department has maintained a field station at Carna for several years which is used for the Easter holiday course as well as for research by staff and students. It is located about 30 miles from Galway. The building is approximately 40 x 60 ft and Ó Céidigh has managed to convince the University of the need to make some basic improvements in it in recent years. It now contains power and benches and chairs but little else. He has plans to include seawater lines but, since the station is relatively close to the department the equipment will be brought to the station as it is needed. Not far from the station the University owns a house which is used as a dormitory for classes which come to Carna. In recent months Ó Céidigh has obtained a "motor launch," the UNA WAND which he hopes to convert to a research vessel for use in the more coastal areas of Western Ireland. She is wood, 46 ft long with an 11 ft beam, and is presently powered by 2 50-HP engines. Seven people can be accommodated and Ó Céidigh has already indicated to scientists from other Irish institutions that she will be available for their use.

Ó Céidigh has been interested in zooplankton of Galway Bay since the time of his own graduate research for the PhD at Dublin. His dissertation, still waiting to be rewritten for publication, contains a tremendous amount of data on seasonal changes in distribution of zooplankton, and he and his students have continued and expanded several phases of this work. The surveys have concentrated in three general areas on the West Coast of Ireland: Kilkerrin Bay, the waters off Mutton Island, and off the Aran Islands where the direct influence of the ocean could be compared. In Kilkerrin Bay emphasis was placed on decapod larvae, their distribution and abundance in relation to season, and the spawning periods of the adults. In the waters off Mutton Island the population of decapods was compared with that described from the other areas and copepods were also studied, resulting in the recording of four species new to Ireland and two which are possibly new species. In the Aran Islands the study of decapods and copepods was continued and a separate study resulted in the identification of 25 species of medusae from the area. More recently this work has been expanded to include a study of littoral and sub-littoral amphipods, a qualitative survey of the polychaetes and lamellibranchs, and the effect of the 1962-63 winter on distribution and survival of the scallop population.

Mrs. J. Fives, Demonstrator in the Department, is completing a study of the fish larvae in the plankton of the west coast. She has now compiled an impressive record and description of these larvae with accompanying data

on their distribution in relation to depth, temperature, salinity, and "water type," based on plankton indicators. She is now interested in the culture of some of the larvae but facilities for this type of work are not available at the present time.

In the Botany Department, Prof. Maureen de Valera has been interested in marine algae for some time. Her present interests are devoted largely to making some order of the chaos which exists in the taxonomy of the algae, and to establish a herbarium at Galway. In all of Ireland there is no phytoplanktologist and Prof. de Valera obviously feels that this area of the marine sciences has been neglected.

Mr. R. Keary, an Assistant Lecturer in the Geology Department, has been investigating the composition of the beach sediments on the west coast. He has examined shelly sands which contained 50-70% organogenic carbonate and has succeeded in partially identifying the types of animal and plant which contributed to the carbonate fraction. He feels that the carbonate-bearing beach sediments are more common on the west coast than the present theory would allow and postulates that it might be possible to make some predictions about the nature of the shelly off-shore fauna in the zone affected by tidal and wave movements, possibly to a depth of 40 ft.

In the Biochemistry Department, Prof. C.Ó. hEocha and several of his students are developing a program of research on the biochemistry of green algae, emphasizing the photosynthetic pigments in several species. They have isolated and characterized phycoerythrins and phycocyanins from eight species of cryptomonads, comparing absorption spectral characteristics with those of previously described cryptomonad biliproteins. They are continuing to work on the fluorescence spectra of the biliproteins which they recorded for the first time several years ago. Ó hEocha has worked in the United States, continues to maintain contact with scientists there, and is obviously well informed of current trends and the equipment necessary to do the research.

Plans for a Marine Laboratory

In 1962 recommendations for the establishment of a new marine biological laboratory were accepted by the government. Since then it would appear that differences of opinion, individual as well as institutional, have prevented any real progress toward the planning and building of this facility which is so obviously needed. The contention is made that initially the scientists associated with the Department of Agriculture and Fisheries delayed the development of the laboratory because its placement on the west coast would require them to leave the advantages of metropolitan Dublin. Last year, however, property was acquired not far from Galway for the laboratory. Its location, a small estuary with sizable fluctuations in salinity, will seriously

limit the types of research which could be done. Individuals within the university community are reluctant to criticize the location for fear the entire project will be dropped or because the criticism will result in the selection of an alternate site on the east coast. Late in 1966 a meeting was held in Belfast to consider the development of marine biology in Ireland, including a discussion of the plans for a laboratory. Each of the universities was represented as well as the Ministry of Agriculture and Fisheries from Northern and Southern Ireland. Because of increased interest in the ocean sciences there was general concern that future developments might result in the establishment of many small field stations, none of which would be large enough to be competitive in the international field. A number of conclusions were reached on future developments. It was agreed that it is not practicable to combine fisheries laboratories and marine biological laboratories, largely because they differ in their aims and in their work. It was recommended that this be made clear to the "authorities" by the analogy of existing laboratories in other countries. Future developments should aim at providing two large marine biological laboratories in Ireland, one on the east coast and the other on the west coast. It was recommended that the existing facilities at Portaferry and Carna be expanded to fulfill this purpose and a letter containing these recommendations was to be sent to appropriate university and government officials in Eire and Northern Ireland.

Various possibilities for cooperative teaching programs were also considered. This included the exchange of both students and staff for various undergraduate courses in marine biology, the pooling of funds to enable visiting lecturers to be brought to Ireland, and the offering of uncommitted table space at Naples to other institutions. Unfortunately no definite plan of action was decided upon and it was left open for any person who was interested to develop a program.

General Comments

In many ways the picture of the marine sciences in Irish universities resembles a micro-cross-section of the field in U.S. institutions. There are those who are trying desperately to improve the teaching and research facilities, inspire and direct the students toward good basic research, and generally create an atmosphere which is conducive to greater individual exchange at the international level. These individuals receive little encouragement from others who are content to continue as they have with little recognition of the role which the universities can play and even less financial support for research. The differences of opinion between university and fisheries personnel have contributed little toward achieving goals which should be mutually beneficial. In a country which could benefit from the general theme of cooperative research which is included in the concept of the International Biological Program, the vast majority of scientists were not aware of the Program and those that knew of its existence were not developing their own participating programs. One major difference between the situation in Ireland and the U.S. is the

support for research. Small grants do exist, through the Department of Fisheries and Agriculture and other government agencies, but in the former the research must have direct application to the fisheries problems in Ireland and the funds for basic research are severely limited. A number of scientists have received support from agencies of the U.S. Government and it has meant a great deal in acquiring specialized equipment, providing support for promising graduate students, and giving them an opportunity to attend an occasional scientific meeting in Europe. Most realize, however, that this support is temporary and that comparable funding may not be available from their own government when the U.S. support is terminated.

Many of the scientists have some contact with U.S. colleagues, are familiar with modern trends and equipment, and in some departments apparatus is available for physiological and biochemical studies. The variety and quantity which one frequently observes in U.S. laboratories is not seen but it should be possible to undertake a wide range of studies if one selected the facility with this in mind.

The staff of the Irish universities, both north and south, represent a very close group. Many have known each other since graduate school days, have had the same professors, and retain a detailed knowledge of each others interests and ideosyncrasies. In most of the universities there is an atmosphere which one rarely sees in American institutions today, and which was presumably a basic concept in the formation of colleges into universities long ago. At Galway Prof. Ó Céidigh introduced me to the professors of archaeology, botany, biochemistry, geology, political science, sociology and history. All were on a first name basis, knew of the courses in the other departments, and were familiar with general lines of research of their colleagues. One got the impression that here was the original interdisciplinary approach to education, without any of the publicity or effort which one encounters in the US.

The individual is still very much a part of the educational process in Irish institutions, at the level of the student as well as that of the staff. In addition to knowing their academic counterparts in other departments and universities many of the Irish scientists are involved in a variety of extracurricular affairs. Powell has just completed a syllabus for secondary school biology (the first occasion on which the biological sciences will be taught in Irish schools) which was modeled after the A.I.B.S. series in the US. Prof de Valera, daughter of the President of Eire, is well informed in a variety of fields other than marine algae. Prof. Ó Céidigh, in addition to knowing most of the fishermen and pub-keepers on the West Coast, considers himself an authority on the "US War between the States" and sleeps in a bed which reportedly belonged to Jeff Davis a few years ago. It is difficult to imagine the "publish or perish" concept being taken very seriously in such an atmosphere. While it cannot be described adequately, a glimpse is provided by considering the old Irish air which provided a

most singularly appropriate name for the newly acquired research vessel at University College, Galway:

UNA WAUN
(Fair Una)

O Una Waun, tis thou my ruin hast wrought
O Una, tis thou me nigh my scul's deep despair hast brought
O Una, my undoing till death thou has me enthralled
O for ever my heart shall love thee
Farewell Una Waun

PUBLICATIONS BY SCIENTISTS IN IRELAND

- Beedham, G.E. and G. Owen, 1965. The mantle and shell of Solemya parkinsoni. (Protobranchia: Bivalvia). Proc. Zool. Soc. London, 145: 405-430.
- Boaden, P.J.S., 1965. Two new interstitial Gastrotricha of the family Thaumastodermatidae. Publs. Stazione Zool. Napoli, 34: 219-225.
- Boaden, P.J.S., 1963. The intertidal Turbellaria Kalyptorhynchia from some North Wales beaches. Proc. Zool. Soc. London, 141: 173-205.
- Boaden, P.J.S., 1963. Behavior and distribution of the archiannelid Trilobodrilus heideri. Jour. Mar. Biol. Assoc. U.K., 43: 239-250.
- Burd, A.C. and J. Bracken, 1965. Studies on the Dunmore herring stock. 1. A population assessment. I.C.E.S., 29(3): 277-301.
- deValera, M., 1962. Some aspects of the problem of the distribution of Bifurcaria bifurcata (Velley) Ross on the shores of Ireland, North of the Shannon Estuary. Proc. Roy. Irish Acad., 62: 77-99.
- Duhig, M. and C. Humphries, 1955. Amphilocheus brunneus Della Valle, an amphipod new to Britain and Ireland and notes on other amphipods not previously recorded in Irish coastal waters. Proc. Royal Irish Academy, 57; (8): 123-129.
- Duhig, M., 1960. The amphipoda of Dalkey Island and its neighbouring waters. Proc. Royal Irish Academy, 61 (4): 59-77.
- Gotto, R.V., 1965. Clionophilus vermicularis: a sponge dwelling copepod new to the British Isles. Irish Natur. J., 15: 20.
- Gotto, R.V., 1963. Observations on the structure, affinities, and biology of a rare copepod, Eunicicola insolens (T. and A. Scott). Proc. Zool. Soc. London, 140: 47-56.
- Gotto, R.V., 1961. A new lichomolgid copepod, and the occurrence of two little-known cyclopoids in British waters. Crustaceana, 3: 85-92.
- Howie, D.I.D., 1966. Further data relating to the maturation hormone and its site of secretion in Arenicola marina Linnaeus. Gen. and Comp. Endocrinology, 6(3): 347-361.
- Howie, D.I.D., 1965. Evidence for a feedback mechanism influencing spermatogonial division in the lugworm (Arenicola marina L.). Gen. and Comp. Endocrin., 5(1): 40-44.
- Ó Céidigh, Padraig, 1963. A list of Irish Marine Decapod Crustacea. Nat. Mus. of Ireland, Government Publications Office, Dublin.

- Ó Céidigh, Padraig, 1962. The marine decapoda of the counties Galway and Clare. Proc. Royal Irish Academy, 62(11): 151-171.
- Ó hEocha, C., P.O. Carra, and D. Mitchell, 1964. Biliproteins of Cryptomonas algae, Proc. Roy. Irish Acad., 63: 191-200.
- Ó hEocha, C., 1965. Phycobilins. Chemistry and Biochemistry of Plant Pigments (Ed. J.W. Goodwin), 175-195. Acad. Press, N.Y. and London
- O'Riordan, C.E., 1967. Cirripedes in Ireland (Irish Cirripedes in the collection of the National Museum of Ireland and in the literature). Proc. Royal Irish Academy, 65(10): 285-296.
- O'Riordan, C.E., 1966. The copepod fauna of the inshore plankton of Dalkey, Co. Dublin, Proc. Royal Irish Academy, 64(19): 355-370.
- O'Riordan, C.E., 1966. Parasitic copepods in the collections of the National Museum of Ireland. Proc. Roy. Irish Acad., 64: 371-378.
- O'Rourke, F.J., 1961. Presence of blood antigens in fish mucus and its possible parasitological significance. Nature (London), 189: 943.
- Owen, G., 1961. A note on the habits and nutrition of Solemya parkinsoni (Protobranchia: Bivalvia). Quart. J. micr. Sci., 102: 15-21.
- Powell, B.L., 1966. The control of the 24 hour rhythm of colour change in juvenile Carcinus maenas (L.), Proc. Royal Irish Academy, 64(21): 379-399
- Powell, B.L., 1962. Types, distribution and rhythmical behaviour of the chromatophores of juvenile Carcinus maenas (L.), J. Anim. Ecol., 31: 251-261
- Williams, G., 1954. Fauna of Strangford Lough and neighbouring coasts. Proc. Royal Irish Academy, 56: (3), 29-133.

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<p>The review gives a general account of marine sciences in Northern Ireland and Eire. From a recent visit a description is given of the staff and facilities of the following institutions: Marine Laboratory, Portaferry, Northern Ireland; Zoology Department, Queen's University, Belfast; Zoology Department, Trinity College, Dublin; Zoology Departments of the University Colleges in Dublin, Cork, and Galway. General trends in the marine sciences and plans for future development are discussed. The appendix contains a bibliography of current publications.</p>			

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